Out of the CLASSROOM, into the HOME

TUNED_IN/THINKSTOCK

Tracey Muir

Try these two strategies to engage students and their parents in authentic mathematical activities at home.

In Australia, the term *numeracy* is used to describe "the competence and disposition to use mathematics to meet the general demands of life at home, in paid work, and for participation in community and civic life" (Australian Association of Mathematics Teachers 1997, p. 15). The implemented mathematics curriculum is responsible for introducing and developing the mathematical underpinning of numeracy (Department of Education, Community, and Cultural Development [DECCD] 1997), but the nature of numeracy suggests that it cannot be developed solely within mathematics lessons and classrooms and that it cannot be assumed that learning mathematics will automatically produce numerate students (Murcia, Powell, and Van Wyke 2006). The ability to use their acquired mathematical knowledge, understanding, and skills in everyday situations requires that students develop experience and confidence (DECCD 1997); the two programs outlined in this article provide opportunities for this to occur.

FIGURE 1

Before students began an investigation, their parents read an information sheet outlining the purpose of and procedure for doing the investigation.

Counting with the Count

Each week, the Count will visit the home of a student in grade 3/4M. The purpose of this visit is to engage your family in doing a numeracy activity together.

Each week, we will have a different investigation for a family to investigate. Every student must record a plan of their investigation, together with what they have found out.

For example: The Count may want to investigate how many liters of milk your family drinks in a week. You then need to decide how you would collect this information—you may keep a tally of every carton of milk you drink, or you may construct a graph to keep count—it's up to you!

At the end of the week, record what you found out, take a digital photograph of you and the Count carrying out the investigation, and return the Count and the Count's diary to school.

You also need to think of a challenge for next week's family to investigate. (Investigations should be suitable for completion in a week.)

Thank you for your time. Happy counting!

It has long been recognized that parents play a significant role in their children's education, so it seems sensible to involve parents in assisting their children to become numerate students. Many parents, however, are apprehensive of participating in school-based mathematical activities, often due to a lack of confidence in their own abilities or a belief that they have little to offer (Murcia, Powell, and Van Wyke 2006). In an initiative conducted by Murdoch University, designed to inform and improve students' numeracy progress, researchers found that—

> the best way to involve the maximum number of parents was for students to interact with their parents on a task with numeracy demands at home, in an environment where parents didn't feel intimidated. (Murcia, Powell, and Van Wyke 2006, p. 19)

In this article, we look at two programs that the author developed and used with two different classes to engage families in numeracy experiences. The aims of the programs are to challenge perceptions of numeracy homework as being limited to the learning of basic facts and

TRACEY MUIR

As part of their at-home investigations, students were asked to take a digital photograph of their participation in the activity.

completion of number activity sheets (Warren and Young 2001) and to supply parents with a greater awareness of the nature of the mathematics undertaken in their child's classroom.

Counting on the Count

The use of investigations and responding to open-ended questions have been recognized as authentic practices that promote higher-level thinking, cooperative effort, extension, and communication (Sullivan and Lilburn 2006) and were the basis of the first program described in this article. As a practicing classroom teacher, Muir regularly presented her grades 3–4 students with the opportunity to engage in mathematical investigations and was keen to extend this to the home environment. A colleague who taught in grade 1 had a class bear who would "visit" the home of a different child each week. During the week, the child would keep a diary and write about the bear's adventures in his or her home. Muir thought that the idea could be readily adaptable to her class of eight- and nine-year-olds, with a focus on completing a mathematical investigation during the course of a week, using the Count from Sesame Street™ as a substitute for the bear.

Before commencing the investigations, parents received an information sheet outlining the purpose and procedure for doing the investigation (see **fig. 1**). Students were enthusiastic, each week hoping that they would be selected to take home the Count. After completing the investigation, the student (and family) suggested a new investigation topic for the Count's next visit; the title of the investigation was recorded by the teacher on the subsequent investigation sheet (see **figs. 2** and **3**). Sometimes this required adaptation on the teacher's part, but overall, the suggested investigations were appropriate. During the term, investigations that students carried out included the following:

- How much milk does your family drink in a week?
- How many hours do you sleep in a week? How many average hours do you sleep per night?
- How many hours per week do you watch TV?
- How many slices of bread does your family eat in a week?

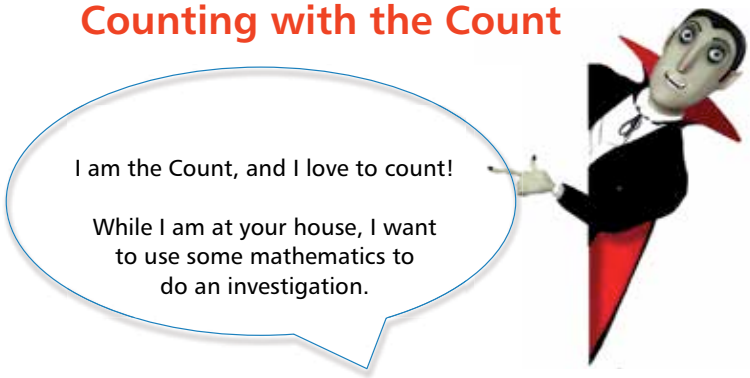
TRACEY MUIR

Colorful bags kept the investigation materials together and protected; but next year, we will use clear plastic bags.

FIGURE 2

After recording his investigation of how much milk his family consumes in a week, Con and his family suggested a topic for the Count's next visit. His teacher noted the new title on a subsequent investigation sheet.

Counting with the Count



Title of investigation:
How much milk does the Clifford family drink in a week?

How will you carry out your investigation?
Counting the 2 and 3 Litre cartons and adding it all up at the end.

2	3
1	2½
2 L	+ 6½ L
	= 8½ L

What did you find out?
The Clifford family drinks and uses 8½ Litres of milk per week.

FIGURE 3

John recorded his family's investigation of Con's suggested topic: How many hours do you sleep in a week? How many average hours do you sleep per night?

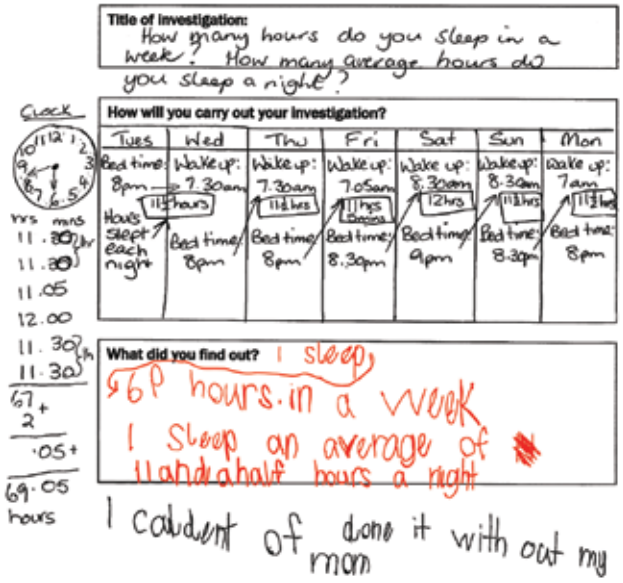


FIGURE 4

Crystal's notes document her TV-watching hours, but her mathematics is incorrect.

- How many different types of vegetables does your family eat in a week?
- What does a million look like? Is there something that you could collect a million of in a week?

Muir asked students to write a plan of how they intended to carry out their investigation, compile a summary of what they found out, and take a digital photograph showing their participation in the activity. Work samples showed that students were prepared to keep detailed records of what they did and the steps involved in working out solutions to their investigations (see **figs. 2** and **3**).

Students recorded solutions that provided useful insights into their mathematical thinking and ability to carry out an investigation. Although acknowledging that parental assistance was often given (and deliberately encouraged), work samples frequently revealed areas of weaknesses that could then be addressed and worked on explicitly in a classroom situation. Crystal's work sample (see **fig. 4**), for example, shows errors in adding minutes and converting them to hours. She recorded the shows that she watched on television: *Bluewater High,* 15 minutes; *Mister Bean*, 15 minutes; *Chalk Master*, 15 minutes; and *Home and Away*, 30 minutes. Note that she did not record minutes on the sample. Her work shows that she watched a total of 75 minutes, or 1 1/4 hours, not 1 1/2 hours as she recorded. Subsequent conversations with Crystal confirmed her confusion, and Muir was able to address this confusion in future teaching about time.

The investigative nature of the tasks also gave parents insight into their child's thinking, mathematical work, and use of NCTM's five process strands (2000). The nature of the tasks also supported recommendations outlined in NCTM's (1991) Teaching Standards: The tasks involved sound, significant mathematics; engaged students' intellect; represented mathematics as an ongoing human activity; and promoted the development of students' dispositions to do mathematics.

Numeracy in a bag

Although satisfied with how students engaged in home investigations as well as their ongoing

enthusiasm, the author was aware that this activity was catering to only one child per week and that potential existed for all students to engage in regular, purposeful numeracy activities at home. The inspiration for Numeracy in a Bag again came from a common literacy practice. Many younger students have engaged in the practice of home readers, regularly borrowing books to take home to share and read with their parents. Muir wanted to offer children the numeracy equivalent of this experience, in that it should be ongoing and in the form of practice to consolidate mathematical skills and concepts learned in class.

Working with a combined grade 1–2 class (six- and seven-year-olds), the challenge was to organize approximately thirty numeracy-based activities that could be undertaken at home; would complement the work they had done in class; and would require such minimal or easily acquired materials as cards, counters, and dice. To maximize the learning and to make the activities engaging and something the family would want to participate in, the selection of the activities was guided by the following:

- A strong emphasis on mental computation—This aspect was partly to address the perception that math homework involves completing pages of sums and partly because of the school's focus on and belief in the importance of mental computation.
- Relevance to classroom activities—Selections were essentially familiar to the children and were intended to either extend or consolidate the work they had done in class.
- Engaging, motivating choices—Because one goal was to involve other family members in the activity, accessibility at a range of levels was an important consideration, as was the potential for repeated participation; games and puzzles particularly met these criteria.

Moreover, Muir was keen to demonstrate to parents the particular math behind the activities in which their children engaged. Instructions for each activity, therefore, accompanied brief explanations about the relevance of the mathematics, suggested questions for parents to ask their child, and presented ideas for simplifying or extending the activity. For example, the following notes for parents accompanied the What's Missing activity (see **fig. 5**):

> This activity reinforces the sequence of numbers from 1–10. It is important that children are able to reproduce the standard list of counting words, in order, and then connect this sequence in one-to-one correspondence with items that are being counted. You can assist children with this by looking at numbers that come before and after and matching the oral names with the numerals and with objects. The use of the cards also encourages *subitizing*, which is instant recognition of a number of objects without counting each one individually.

FIGURE 5

What's Missing? is an example of a take-home activity.

What's Missing?

What you will need

1 set of cards 1–10 for each pair

What to do

One person holds the cards facedown and closes his or her eyes.

The partner takes one card and hides it.

To identify the missing card, the first person lays the cards out.

The partner confirms the correct answer.

The partners swap roles.

Suitable take-home activities

The following activities could be used or easily adapted to suit a range of classes:

- Hundred chart jigsaw puzzles—Laminate and cut up a hundred chart; different versions can be made and can even include blank spaces to make the task more challenging (see **fig. 6**).
- Ten-frames—Offer laminated ten-frames and counters to encourage children to subitize and practice recall of combinations of ten.

- Counting collections—Provide plastic zipper storage bags of interesting small counting materials (such as craft-shop ladybirds, shells, beads) to encourage counting in groups and the use of multiplication, rather than repeated addition.
- Calculator activities—Large A4 calculators offer a novel way to introduce young children to using this device; include instructions on how to make the calculator "count" (e.g., to count in threes, press 3 + + =), and have children practice their skip counting by predicting the next number before the calculator does.
- Card games—Remove the tens and picture cards from a deck of cards and play versions of well-known card games, such as Memory, to match compatible numbers to ten. For younger children, such games as What's Missing? (see **fig. 5**) provide practice with establishing the counting sequence 1–10.

FIGURE 6

Make different versions of this game; including blank spaces will increase the game's challenge.

Directions for hundred chart jigsaw puzzles

What you will need
The cut-up pieces of a 1–100 chart

What to do
Place the pieces together to form a chart showing the numbers 1–100.

Purpose of activity
This activity is designed to foster the development of an understanding of many concepts. By placing the pieces together, children can form an understanding of the place-value system and the sequence of two-digit numbers. After assembling the chart, children can be asked to locate patterns in the chart (e.g., Find the multiples of 11; cover them with counters. What do you notice?).

Counting with the chart
Children can use the chart to add and subtract two-digit numbers. For example, have students place a finger on the 23. To add 34, have them move their finger down three rows (each row represents ten) and across four columns (each column represents one). Have them try adding a variety of numbers in this way.

Subtracting two-digit numbers can also be attempted using the chart (e.g., 67 – 32 can be found by moving from the 67 up three rows and across two spaces).

36 + 43 =

- Dice and dominoes—These are inexpensive, easily accessible items that give children opportunities to practice subitizing and such addition strategies as counting on, bridging ten, and doubling.

Implementation in the classroom

Thinking of thirty completely different activities was unnecessary. Many ways exist, for example, to use a hundred chart and jigsaw puzzles, and it is reasonable to expect children to revisit the activities to consolidate particular mathematical concepts and skills. Muir also found that having a bank of about thirty activities and then introducing three or four new activities per month worked well. The thirty activities were initially designed to complement the work done in the classroom, and they primarily concentrated on number. Provision was made, however, to introduce new activities to reinforce and consolidate focus on a particular area (e.g., money and time), which also helped motivate students. The new activities and calculator activities proved to be the most popular. Laminating the activities requires initial preparation time but ensures that the activities are reusable and do not need ongoing replacement. The use of accessible, inexpensive materials guarantees that replacement, when necessary, can be easily undertaken. The author's team used bright, colorful cloth to make the bags, which protected the materials and kept them together. The highly visual nature of the bags also served to raise awareness throughout the school and wider community of the concept to "engage families in numeracy."

Each week, the teacher would allocate a different numeracy bag to each student, who would take the activity home and bring it back to school a week later. The student would then receive a different bag to take home. This usually meant that the teacher was able to allocate appropriate bags (in terms of their mathematical challenge) to each student. However, the teacher found that after a while, students would request particular bags or activities or that sometimes the most appropriate activity was unavailable for particular individuals. Parents also commented that some activities were either too easy or too challenging for their child, so this aspect ought to be monitored throughout.

Parental feedback

Feedback sheets were included with each weekly activity, survey, and interview. In addition to commenting on the appropriateness of the activities, parents also had the opportunity to comment on the mathematical behavior of their child. The following are illustrative of the nature of the comments written by parents on the weekly feedback sheets that they returned to the school:

- Tim understood the rules easily. He did make a couple of errors at the beginning but it came to him the more he played it.
- She placed the counters in a logical way and could easily tell me how many counters she needed to make 10.

Three parents participated in a follow-up interview, which gave the author detailed information on how the numeracy bags were used at home and how parents perceived their benefits or otherwise. Because one of the aims was to give parents a greater understanding of the nature of mathematics undertaken in their child's classroom, Muir specifically asked them about this aspect. The following are indicative of the types of comments that were returned:

- "Yes, because I've never realized that they were the types of activities they do and I wasn't sure what the standard was and it was quite interesting to see that that's what my child does" (Melissa 16-12-2008).
- "Yes, because it sort of showed up with some of the games—like even though it looked like you were just playing a game, you could see the benefit of the numeracy and the math skills that were in it" (Felicity 16-12-2008).

Improving the process

Feedback from parents and the classroom teacher indicated that students were keen to

Cutting up a hundred chart and laminating the pieces can yield activites for a range of abilities. Including blank cards will make the activity more challenging.

borrow the numeracy bags and participate in the activities. Their interest level and enjoyment were maximized when activities were suitably challenging for them, so this would be an important consideration for other teachers seeking to implement a similar program. This goal could be achieved through either labeling bags in terms of their relative difficulty or ensuring an adequate range of difficulty for the teacher to allocate appropriate challenges to each individual. Next year, Muir and her colleagues will also look at placing the activities in clear bags (for ease of viewing) and will try a self-selection process whereby students and parents will choose the activities (with teacher support if necessary) in much the same way they decide on their leveled home reading books. Some students in the class did not reliably return their numeracy bags (or their home readers); they could not borrow another activity until they returned the first one. Along with encouraging these individuals and their parents to participate in the activity, the teacher also provided some in-class time for these students to access the activities so they did not feel completely left out.

The importance of partnerships

Collaborative learning communities have been increasingly emphasized as being significant in supporting children and adults as lifelong learners; according to Warren and Young (2001), parent participation should underpin all strands of school policy as well as create and sustain seamless links between home and school contexts. Reading to children and listening to children read at home have been acknowledged as important undertakings for helping children become literate (Calfee 1997, as cited in Warren and Young 2001), yet no widespread similar practice seems to exist to encourage parents to engage in regular numeracy experiences with their children. The two projects described in this article offer examples of how to use home and school partnerships to engage children in mathematical activities, along with providing parents with an accurate picture of the types of mathematical experiences that are beneficial for their children.

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